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AUTHOR: Pokatilov, Ye. P.

TITLE: The electroacoustic effect with h-f ultrasonics

SOURCE: Kishinev. Universitet. Uchenyye zapiski. v. 49, 1961, 26-28

TEXT: On the basis of quantum perturbation theory the electron-phonon interaction is studied for a system having an electron collision frequency smaller than the sonic frequency. Using a method of Herring and Vogt (Phys. Rev. 101, 944, 1956), the zero-current field strength inside an isolated semiconductor is derived as

$$E_{\alpha'}^{(l)} = \frac{2\pi g C_{\alpha' p(l)} W_0 kT}{e m_{\alpha'}^{\frac{1}{2}}} \left[\frac{2\hbar\omega}{p^2}\left(ch\frac{\hbar\omega}{KT}-1\right)+sh\frac{\hbar\omega}{KT}\right]\times \tag{1.2}$$
$$\times m_{\alpha'}\int f_0\tau_{\alpha'}d\varepsilon \Big/ \int f_0\tau_{\alpha'}\xi^4 d\xi$$

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from the equation of motion of electrons in the sound field.

$$C_{\alpha' p(l)} = \frac{q_{\alpha'}}{\left(\sum q_s^2 \frac{m_{\alpha'}}{m_{\beta'}}\right)^{\frac{1}{2}}}$$

(1.2) holds for a nondegenerate carrier gas, whereas for a degenerate gas

$$E_{\alpha'}^{(l)} = -\frac{3 C_{\alpha' p(l)} W_0^{(l)} m_{\alpha'}^{\frac{1}{2}}}{e} \cdot \frac{\hbar\omega}{\sqrt{\mu_0}} \tag{1.4}$$

is valid. For high temperatures, $\hbar\omega/KT \ll 1$,

$$E_{\alpha'} = -\frac{3C_{\alpha' p(l)}}{2e} W_0^{(l)} kT m_{\alpha'}^{\frac{1}{2}} \left[\frac{\hbar\omega}{p^2}\left(\frac{\hbar\omega}{KT}\right)^2+\frac{\hbar\omega}{KT}\right]\times$$
$$\times\int exp(-\varepsilon/KT)\tau_{\alpha}\, d\varepsilon \Big/ \int exp(-\varepsilon/KT)\tau_{\alpha'}\xi^4 d\xi. \tag{1.3}$$

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$E_{metal}/E_{semic.} \simeq (KT/\mu_0)^{3/2}$. These relations are used to calculate eE for n-type Si and Ge for longitudinal and transverse oscillations. The electroacoustic effect can be used to determine both interaction constants, whereas other effects, as e. g. the piezoeffect, yield only one.